all MTE for 203 Procedures

Instruction Manual

(602) 278-8515
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Model 2533
DIGITAL POWER METER
(TRIPLE PHASE)

Electronic Services - Los Angeles
M16812X

YOKOGAWA ◆

2nd Edition
IM 2533-03E

Instruction Manual

Model 2533
Digital Power Meter
Service Manual

Supplement

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YOKOGAWA
Yokogawa Electric Corporation

PD No. T and M 10003-R-J(UP)

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IM 2533-03

WARNING

These servicing instructions are for use by trained service personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

SELF TEST

Refer to the Instruction Manual (Self Test on Power ON and Item 4 References) for the information of system architecture, version number of software and error code on power ON.

ROM VERSION

		April 4 1986	July 24 1986
Mount CPU A'ssy (B9278KJ)	Part No. U14 (B9278NA)	VER 1.01	———
	Part No. U14 (B9278NB)	———	VER 2.00
	Part No. U15 (B9278NC)	———	VER 2.00
Instrument Code		25331□	25331□
Optional features	/GP-IB	○	○
	/FRQ	×	○
	/INTEG	×	○
	/RS232C	×	×
Display of version		1.01	2.00

		October 30 1987
Mount CPU A'ssy (B9278KJ)	Part No. U14 (B9278NH)	VER 1.00
	Part No. U1 (B9278NJ)	VER 1.00
	———	———
Instrument Code		25332□
Optional features	/GP-IB	○
	/FRQ	○
	/INTEG	○
	/RS232C	○
Display of version		1.00

Note : Version 2.00 is due to the addition of optional features (/FRQ & /INTEG).

1. ADJUSTMENT MANUAL

1.1 Scope

This manual covers the adjustment of Digital Power Meters
253311, 253312 and 253313 (AC input type).
253321, 253322 and 253323 (DC/AC input type).

1.2 Standard Conditions

Overall adjustment and inspection should be conducted under the following conditions :

- **Temperature** : 23±3°C (73±5°F)
- **Humidity** : 45 to 75% (Relative Humidity)
- **Power** : 115V±3 V (50/60 Hz) (sine wave input)
- **Heat run** : In order to stabilize the temperature inside the equipment, adjustment shall be carried out after a warm-up of at least 30 minutes.

All adjustments are made in the TEST MODE. This setting is to be made when main power is OFF. Remove cover of unit, locate CPU Card - Switch 1. Turn Bit 3 ON, all others off until instructed otherwise.

1.3 Standard Equipment for Adjustments

- **AC voltage standard** : FLUKE Model 5200A ±0.01%
- **Booster** : FLUKE Model 5215
- **AC current standard** : FLUKE Model 5200A ±0.01%
- **Booster** : FLUKE Model 5220
- **Standard wattmeter** : YOKOGAWA Model 288520 ; (10 to 3 kHz) ±0.02%
- **2-phase oscillator** : HP Model 3326A ; FRQ accuracy: Less than 0.01%
  Resolution: 0.01 deg.
- **Digital multimeter** : YOKOGAWA Model 2502 ; ±0.01%
- **DC voltage standard** : YOKOGAWA Model 2552 ; ±50 ppm

2. DISPLAY, KEYBOARD, AND DIGITAL FUNCTION INSPECTIONS

2.1 Conditions

Tests and adjustments should only be conducted when the following assemblies are installed:

Power Supply	:	B9278CE (AC input type)
Do.	:	B9278CN (DC/AC input type)
Mother Assembly	:	B9278JL
CPU Assembly	:	B9278JJ
Display Controller	:	B9278JH
A/D Assembly	:	B9278JD or JV
Display Assembly	:	B9278JK or JW

If unit is equipped with Integrator Board (B9278JS), this board must be removed for the following tests.

Display controller assembly and display assembly are connected with 2 cables.

Use TEST MODE. Turn power OFF, locate CPU Board and Switch 1. Turn Bit 3 ON, all others off, and turn main power ON.

2.2 Items to be Checked

(a) Keyboard Switches
(b) LED
(c) Battery Lamp
(d) Battery Back-up
(e) A/D Start
(f) DIP Switches

(a) Check Keyboard Switch

Press LOCAL switch once to display 2 Dash Marks in Display C. Ignore Display A and B. See Drawing of Front Panel - Page 3a of this manual. As you press each key, the corresponding number will appear in Display C.

(b) Check LED

Press LOCAL switch again. All LED's in all displays will be illuminated and will count up from 0-9. Decimals will sequence right to left. Indicator lamps for keyboard switches will sequence. When all LED's, lamps, have been verified in operating condition, press LOCAL again to continue with procedure.

(c) Check Battery Lamp

With main powr ON, remove battery from rear compartment and check to see that battery LED lights. Reinstall battery and verify that battery LED extinguishes.

(d) Check Battery Back-up for Panel Settings

In normal operation this unit has various DEFAULT settings when power is turned on. These DEFAULT settings are :

Sample light - flashing
Display A - Function V Element 1
Display B - Function A Element 1
Display C - Function W Element 1
Mode - Wiring 3 phase 3 wire Volt RMS
Voltage Range - 600 V - Auto Range OFF
Current Range - 20 A - Auto Range OFF

To verify battery backed-up panel settings, change any of these DEFAULT settings and turn main power OFF. Wait a few seconds, turn main power ON and verify the changes you made are still valid.

(e) Check A/D Start

Push LOCAL to show all zero in Display B and two dashes in Display C.
For this test, prepare a 36 pin mating connector for the Remote Control/Analog Output connector on the rear panel.
Ground the A/D Start terminal (pin 21) to ANALOG COM. (pin 10). Check that Display B changes from 000000 to 000001.

(f) Check for DIP Switch Operation

Locate Switch 1 on CPU Board. Verify all Bits are **off** except Bit 3 which is **on**.

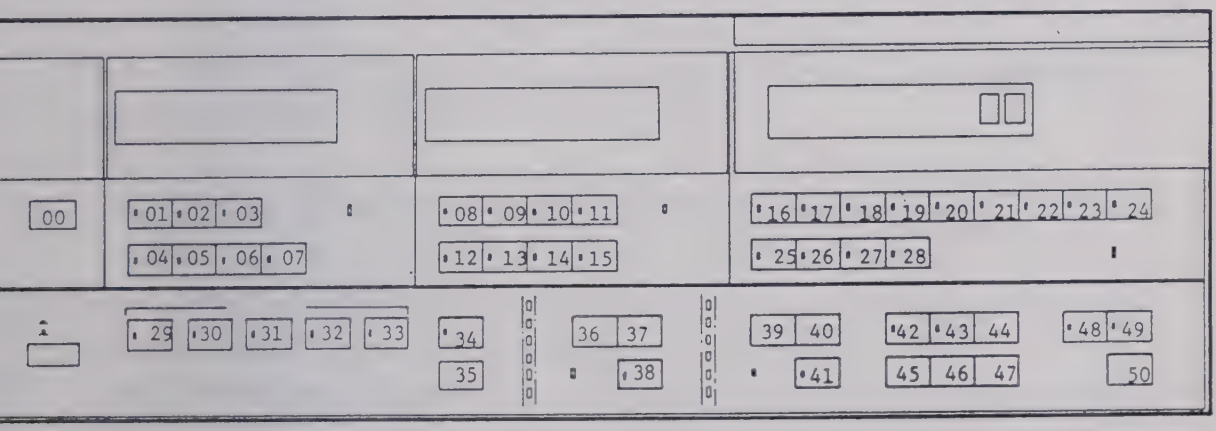
Read DISPLAY A, left most LED as each Bit is turned on, then off, as in following chart.

Bit Number	Display A
1	1XXX
2	2XXX
3	4XXX
4	8XXX

XXX don't care

(3)

To Use in Case of DIP Switch Setting, etc.



This completes Front Panel Function TEST.

Restore Bit 3 Switch 1 on CPU Board to off.

3. POWER SOURCE ADJUSTMENT AND CHECK

This test is made on the Power Supply Assembly (B9728JM) which is located on the left side (from front) behind Display board. MAIN power switch ON.

3.1 Check for ±15 V Power (AC input type)

(1) Connect DMM "L" side to the A. GND (TP4) and the DMM "H" side to +15 V (TP3) and read the display +15 V ± 0.5 V.
(2) Connect the DMM "H" side to −15 V (TP5), "L" side to A. GND (TP-4) and read the display −15 V ± 0.5 V.

3.2 Power +5.03 V Adjustment

(1) Connect DMM "L" side to the D.GND (TP1), and the DMM "H" side to +5 V (TP2). Adjust R16 and read 5.030 V ± 0.005 V.

3.3 Check for ±15 V (for both AC and DC/AC Models)

(1) Connect digital multimeter (DMM) "L" (low) terminal to A-COM (TP3) and "H" (High) terminal to +15 (TP1). Check that the DMM displays +15 ±0.5V.
(2) Connect DMM "H" (High) terminal to −15 V (TP2) and check that the DMM displays −15 ± 0.5 V.

3.4 Power +5 V Adjustment

Connect DMM L (Low) terminal to D-COM (TP5) and H (High) terminal to +5 V (TP4), and adjust R2 so that DMM displays +5,000 ± 0.005 V.

4. A/D ASSEMBLY ADJUSTMENT

Turn power OFF, remove MPX Board (B9278JC) and all RMS Boards (up to 3 depending on model) (B9278JB) and all ribbon cables which connect AC inputs to Mother Board (B9278JL) at connectors CN15, CN16, CN17.

4.1 Sample Lamp Check

Turn on MAIN Power and check to see that Sample light flashes on upper left front panel. Make sure the **SAMPLE HOLD SWITCH** on front panel is **OFF**. Using a stop watch, verify the flashes on the SAMPLE light occur every 0.4 seconds.

4.2 Reference Voltage Adjustment

Test is performed on A/D Board B9278JD.

Using DMM, connect "L" side to A.COM (TP5) and Ref. voltage (TP4) (4.93V) and turn adjuster R35 (V Ref) so that the display indicates 4.980 V ± 0.001 V.

4.3 Zero Adjustment (A/D Board B9278JD)

With main power ON, and using jumper leads, connect A.COM (TP5) to CH1 (TP1), CH2 (TP2) and CH3 (TP3). Reading results in the Display A, B, and C of the Power Meter (2533), turn adjuster R30 (zero) for CH1, adjuster R32 (zero) for CH2, and adjuster R34 (zero) for CH3 to read 0 ± 1 digit in Display A (CH1), Display B (CH2), and Display C (CH3) respectively.

4.4 Full Scale Adjustment (A/D Board B9278JD)

Connect the DC Calibrator output ("H" side) to CH1 (TP1), CH2 (TP2), and CH3 (TP3) in parallel. Connect "L" side of calibrator to A.COM (TP5). Set output to 5.000 V DC and turn adjuster (s) R29 (F.S.) for CH1, R31 for CH2, and R33 for CH3 to show +20000 ± 2 digits in Display A, B and C respectively.

5. RMS ASSEMBLY ADJUSTMENT INSTRUCTIONS

5.1 Preparation

Turn main power OFF and install RMS Board(s) into their appropriate slots. In the case of ; Model 253311, only one RMS Board is used, Model 253312, two boards, and Model 253313, three boards. For polyphase you must also install MPX Board.

RMS Board B9278JB-1, 2, 3 in slots right to left respectively.

MPX Board B9278JC in respective slot.

Do not connect ribbon cables from AC Input at this time.

Adjustment is to be carried out in the TEST MODE. Locate CPU Board Switch 1 and turn on Bit 3.

All readings are displayed on POWER METER Display A.

The following steps 5.2 (1) thru (12) refer to the adjustment of one RMS Board. You must repeat these steps according to the number of RMS Boards in your unit.

When adjusting RMS Board #1, DISPLAY A Element 1 must be used. For RMS Boards 2, and 3, select Display A, Elements 2, and 3, respectively.

5.2 A RMS, V RMS, and V MEAN Adjustment

(1) Connect AC Calibrator output"L" to S.COM (TP2) and output "H" to V.IN (TP3) and A.IN (TP-4). Use jumper between TP3 and TP4. Turn main power ON.

(2) Set AC Calibrator to 0.1 Vrms (60Hz).

NOTE :For all following adjustments refer to Board Components Layout Figure 5-36 - RMS Assembly B9278JB in your Operators Manual.

(3) Arms Zero (ZR) Adjustment.

Set Display A to Function AMPS, turn adjuster R102 to show 2000 ± 5 digits in display.

(4) Vrms Zero (ZR) Adjustment

Set Display A to Function VOLTS and MODE to RMS.

Turn adjuster R82 to show 2000 ± 5 digits on the display.

(5) Vmean Zero (ZR) Adjustment

Select **MODE - MEAN** and turn adjuster R41 to show 2000 ±5 digits on the display.

(6) Set AC Calibrator output to1.0 Vrms (60Hz).

(7) Arms Full Scale (FS) Adjustment

Set Display A for function AMPS.

Turn adjuster R101 to show 20000 ±4 dights on the display:

(8) Vrms Full Scale (FS) Adjustment

Set Display A for Function VOLTS, **Mode - RMS**.

Turn adjuster R81 to show 20000 ±4 digits on the display.

(9) Vmean Full Scale (FS) Adjustment

Set Display A for Function VOLTS, **Mode - MEAN**. Turn adjuster R42 to show 20000 ± 4digits on the display.

(10) Set AC Calibrator output to 0.1 Vrms (60Hz).

(11) Zero (ZR) Re-Adjustment

Using function/mode keys, read Vrms, Vmean and Arms in Display A, one at a time, and verify that all read 2000 ±2 digits for each setting. If not, refer to steps (3), (4) and (5) and readjust as needed.

(12) If re-adjustment of zero (ZR) in Step (11) was performed, repeat full scale (FS) adjustment as shown in steps (6) to (11). Readings must be as follows:

INPUT	ARMS	VRMS	VMEAN
0.1 Vrms	2000 ± 2	2000 ± 2	2000 ±2
1.0 Vrms	20000 ± 4	20000 ± 4	20000 ± 4

5.3 Watt (W) Adjustment - RMS Boards

These adjustments are performed on RMS Board(s) B9278JB.

(1) Connect **DC** Calibrator output "L" to S.COM (TP2) and output "H" to V.IN (TP3). Jumper S.COM (TP2) to A.IN (TP4).

(2) Zero (ZR) Adjustment

When DC calibrator output is ZERO, turn adjuster R4 (ZR) to show 00000 ±2 digits on Display A, Function W (Watts), Element 1 for RMS Board 1. Repeat for elements (RMS Boards 2 and 3).

(3) A Balance Adjustment

Set A.BAL (R3) to approximately 00000 on Display A, Function W (watts), Element 1 Select DC Calibrator outputs of +1.5 V DC and −1.5 V DC alternately. Turn adjuster A.BAL (R3) to raes ± digit on display according to polarity of DC calibrator output. Repeat on other RMS Boards and Elements 2 and 3 respectively.

(4) Connect DC Calibrator output "L" to S.COM (TP2) and output "H" to A.IN (TP4). Jumper S.COM (TP2) to V.IN (TP3).

(5) V. Balance (BAL) Adjustment

Set V.BAL (R2) so that Display A Function W, Element 1 reads 00000. Select DC Calibrator outputs of +1.5 V DC and −1.5 V DC alternately and turn adjuster V BAL (R2) to show a change of ±1 digit on the display. Also check the **absolute** value on the display is less than ±20 digits. Repeat for all RMS Boards/Elements in your unit.

(6) Connect AC Calibrator output "L" to S.COM (TP2) and "H" output to V.IN (TP3). Jumper V.IN (TP3) and A.IN (TP4) together.

(7) Full scale (FS) Adjustment

Set AC Calibrator output to 1 Vrms (60Hz) and turn adjuster FS (R-1) to show 20000 ±4 digits on Display A, Function W, Element 1. Repeat for other RMS Boards/Elements.

(8) Frequency (F) characteristics adjustment

Set AC Calibrator output to 1Vrms, 20KHz, and turn adjuster Cl to show 20000 ± 10 digits on Display A, Function W, Element 1. Repeat for RMS Boards/Elements in your unit. When finished, turn Bit 3, Switch 1 on CPU OFF.

6. AC INPUT ASSEMBLY ADJUSTMENT INSTRUCTIONS

6.1 Preparation

Turn off main power - disconnect all leads. Connect AC Input assembly(s) to the Mother Board with Ribbon Cables disconnected earlier. Green Trace on Ribbon corresponds with △ index on Mother Board connector. Remove black plastic guard covering AC Input Modules.

6.2 Current Input Zero Adjustment

(1) Turn on main power to unit. Connect DMM "H" input to A (TP3) and "L" input to S.COM (TP2). Set Power Meter Range (AMPS) to 5 A. Turn adjuster R5 to set voltage between TP2 and TP3 to be within ± 0.05 mV DC.

(2) Holding that state select each range from 0.5 A to 20 A in order to check that the voltage is less than ± 0.0 5mV DC.

(3) Repeat steps (1) and (2) for each remaining AC Input Assemblies.

6.3 Voltage Input Zero Adjustment

(1) With the Voltage Input Terminals shorted (rear panel of 2533) and the Voltage Range set to 100 V, connect the DMM input "H" to TP1 and input "L" to input voltage terminals. Turn adjuster R56 to set voltage to be less than 0.1 mV DC.

(2) Holding that state select Input Ranges 30 V-600 V to check that the voltage reading on DMM is less than 0.5 mV DC in each range.

(3) Repeat steps (1) and (2) for each additional AC Input Assembly. When finished remove short from voltage terminals.

6.4 Voltage Input Full Scale (FS) Adjustment

This adjustment is carried out in TEST MODE ; Bit 3 of Switch 1 on CPU is turned ON.
Read results in Display A. Set Function to V and Element 1.

(1) Set Range to 60 Volt Range apply 60 V (60 Hz) to Voltage input terminals - Element 1 - (rear input connections). Turn adjuster "L" (R55) to show 20000 ±1 on Display A.

(2) Set Range to 100 Volt Range. Apply 100 V (60 Hz) and turn adjuster "H" (R60) to show 20000 ± on Display A.

6.5 Voltage Input Frequency Adjustment

(1) 100 Volt Range : Apply 100V (20 kHz) and turn adjuster R61 to show 20000 +50 digits on Display A.

(2) Leave range set to 100V and set input to 100V (6 kHz) and verify the value is 20000 +50 digits on Display A.

6.6 Repeat For Each Additional Element

Repeat Steps 6.4 and 6.5 for each additional element in your unit. Read results on DISPLAY A, Function V and Elements 2 and 3 according to which element is being adjusted.

6.7 Current Range Adjustment

Connect AC Current Standard to current Input Terminals of Element 1. Set Display A for Function A (AMPS) and Element 1.

(1) Apply 2 A (60 Hz) on 2 A Range and turn adjuster R3 (L) of the AC Input Assembly to show 20000 ±4 digits in display A.

(2) Apply 5 A (60 Hz) on 5A Range and turn adjuster R4 (H) of AC Input Assembly to show 20000 ±4 digits on Display A.

(3) Repeat steps (1) and (2) for each element in your unit remembering to select Display A, Element 2 or 3 depending on which one is under test.

7. POWER RANGE ADJUSTMENT

(1) Set Display A to W1, Display B to W2, and Display C to W3. Set measuring ranges to 100 V and 1 A. Verify the displays read 00000 ±3 digits. If not, turn adjuster R4 (ZR) of the appropriate RMS Assembly to show 00000 ±3 digits.

(2) Leave W1, W2, W3 settings in Displays A, B and C respectively, apply 100V, 1A (60Hz) and $\cos\phi = 1$ with ranges set at 100 V, 1 A and turn adjuster R1 (FS) of each RMS Assembly to show 20000 ±4 digits on the display. If your unit is a multiple element version (−12, −13), the single phase voltage and current standards should be connected with voltage elements in parallel and current elements in series. (See drawing - page 13 of this manual.)

Note : This concludes all adjustments for the measuring and display of Volts, Amps and Watts. If your unit contains one or more of the following options, proceed with steps 8, 9, and 10.;

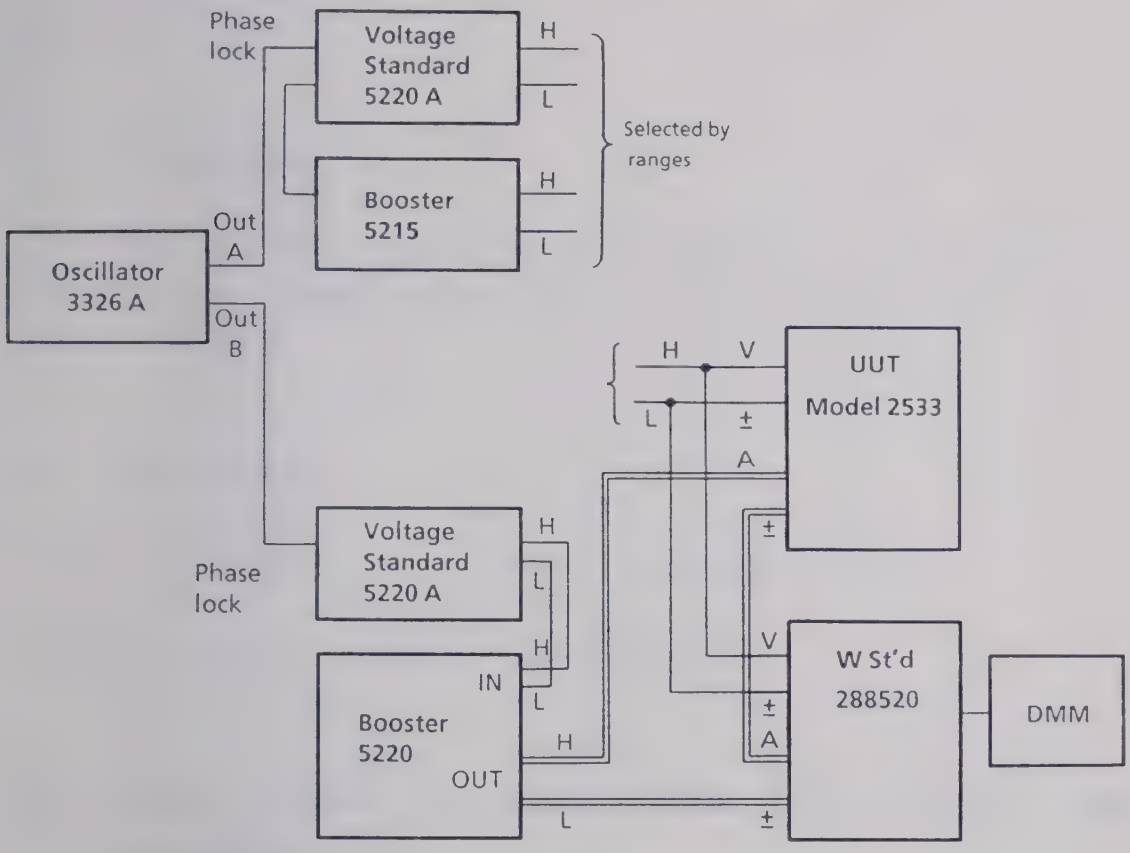
(1) Frequency Measuring Option

(2) Integrator

(3) GP-IB

If none of the above options are present, locate switch 1 on CPU Board and turn BIT 3 **OFF**. Proceed to step 11 to complete ranging and linearity tests on the unit.

- **Standard Equipment Connection Method AC Characteristics**

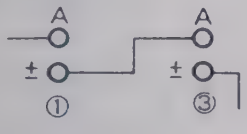


3-phase Type Connection

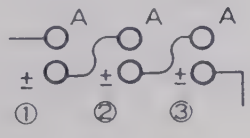
For voltage : (V) parallel each other

(±) parallel each other

For current,
3-phase 3 wire



3-phase 4 wire



8. DC INPUT ASSEMBLY ADJUSTMENT PROCEDURES

8.1 Preparation

To adjust the DC input assembly, use the digital power meter that its RMS assembly is already adjusted. Adjust the Meter DC input assembly in TEST mode (DIP switch 3 ON on CPU assembly, B9278CM).

8.2 Initial Setting

(1) Before turning ON the power, turn ON SW3 on the sub-board (B9278JE).

(2) Set trimmer and rotary switch in the center of rotary switch.

8.3 Voltage Input Assembly and Preamplifier Zero Adjustment

With the meter range set to 60 V and input in short-circuited status, turn R11 until the voltage between COM (TP2) and TP1 is within ±20 μV.

8.4 Current Output Amplifier Zero Adjustment

Set the meter range 5 A and leave input terminals disconnected, turn R38 to obtain that the voltage between COM (TP8) and TP6 is ±50 μV.

8.5 Transformer Damping Adjustment

Set the meter to 60 mV range and the input voltage to 6 V (at 300 kHz), adjust R12 so that the meter displays 2800 ±50 digits.

8.6 Linearity Adjustment

Set the meter to 60 V range, apply a 60 V input signal and observe the display. Next apply a 30 V input signal and observe whether the display is 1/2 ±1 digit of that when the 60 V input signal was applied. If the display is beyond the limits specified, adjust R33 so that the desired voltage linearity is obtained.

8.7 Voltage Characteristics

Set the meter to 60 V AC range and apply a 60 V AC input signal whose frequency is 1 kHz to the meter. Observe the display. Next apply a 60 V AC input signal whose frequency is 60 Hz and observe the display. Adjust R35 so that the display when 1 kHz input was applied is within ±1 digit of that when 60 Hz input was applied.

8.8 Voltage Span Adjustment

(1) Set the meter to 60 V range and apply a 60 V input signal whose frequency is 60 Hz. Adjust R8 so that the meter displays 20000 ±1 digits.

(2) Set the meter to 100 V range and apply a 100 V input signal whose frequency is 60 Hz. Adjust R7 so that the meter displays 20000 ±1 digits.

8.9 Current Characteristics

(1) Set the meter to 5 A range and apply a 5 A input signal whose frequency is 60 Hz. Next apply a 5 A input signal whose frequency is 2 kHz and observe the display. Adjust R31 so that the display when the input whose frequency is 60 Hz was applied is −10 ±1 digits of that when the input whose frequency was 2 kHz.

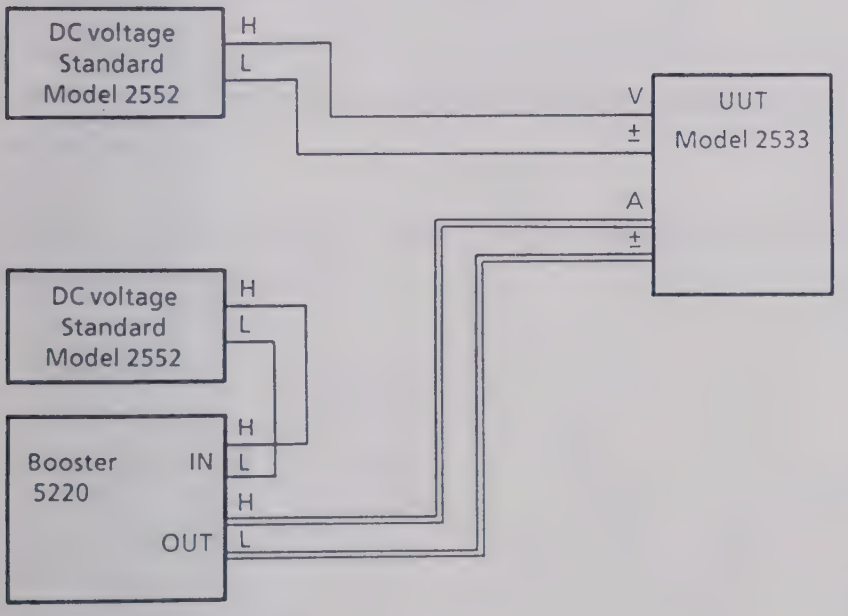
(2) Set the meter to 5 A range, apply a 5 A input signal whose frequency is 300 Hz, and observe the display. Next apply a 5 A input signal whose frequency is 60 Hz, and observe the display. Adjust R39 so that the display when the input whose frequency is 300 Hz was applied is within ±1 digit of that when the input whose frequency is 60 Hz was applied.

8.10 Current Span Adjustment

(1) Set the meter to 2 A range and apply a 2 A input signal whose frequency is 60 Hz. Adjust R36 so that the meter displays 20000 ±1 digits.

(2) Set the meter to 20 A range and apply a 20 A input signal whose frequency is 60 Hz. Adjust R37 so that the meter displays 20000 ±1 digits.

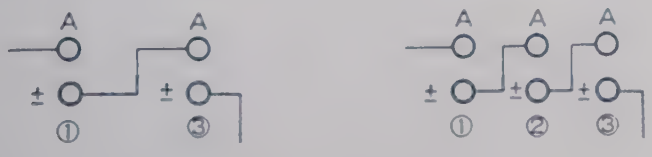
- DC/AC Characteristics



3-phase type connection

For voltage : (V) parallel each other
(±) parallel each other

For current: 3-phase 3-wire 3-phase 4-wire



9. CHECK FREQUENCY ASSEMBLY DIP SWITCH (OPTIONAL)

If your unit is equipped with the Frequency Option, proceed with this step.

(1) Disconnect AC Voltage and Current Standards.

(2) Verify Bit 3 on CPU Board. Switch 1 is ON.

(3) Press LOCAL key for Key Test Mode. If your unit contains the Integrator Option Board, you must press LOCAL key once, wait till Display C stops counting then press LOCAL key again to read Display B.

(4) Locate Dip Switch on Frequency Board. Turn each Bit ON and verify reading in Display B according to the following chart;

Bit Number	Display B
1	01XXXX
2	02XXXX
3	04XXXX
4	08XXXX

Note : X ... don't care

Note: If your unit is equipped with the Optional Integrator or GP-IB, proceed with steps 9 and 10. If not, set Bit 3 on CPU Board. Switch 1 to OFF and proceed to step 11.

10. INTEGRATOR ASSEMBLY ADJUST-MENT METHOD (OPTIONAL)

10.1 Internal Counter Test

Verify that Bit 3 on CPU Switch 1 is ON.

If your unit is a polyphase, then set W1 in display C. With V and A inputs at zero, and input ranges set to 100 V, 2 A, check to see that Display C shows −00005 to +00005.

Press LOCAL key for the Counter Test Mode. Verify that the value in Display C increases by one digit per second to show the following displays.

DISPLAY	DESCRIPTION	DISPLAYED VALUE
A	Upcounter	16E5XX (16) to 16E1XX (16)
B	Downcounter	16E5XX (16) to 16E1XX (16)
C	Timer Counter	00010

10.2 Dip Switch Check

Press LOCAL key for the Key Test Mode.

Turn each Bit on the Dip Switch-Integrator Board- ON then OFF and check the following chart with the values in Display B.

Bit Number	Display B
1	XX01XX
2	XX02XX
3	XX04XX
4	XX08XX

Note: X ... don't care

10.3 D/A Converter Adjustment

The test results for this procedure are measured at the rear connector for the Integrator Board. Connect the DMM "H" side to PIN 7 (analog OUT) and "L" side to PIN 6 (Analog Common).

Switch 1 Bit 1	Switch 1 Bit 2	D/A Output	Note
OFF	OFF	0.000 V ± 0.5 mV	Turn R23
OFF	ON	5.000 V ± 1 mV	Turn R24 (FS)
ON	OFF	−5.000 V ± 2 mV	Check − (FS)

Integrator Test is complete. Return all BITS on Switch 1 (Integrator Board) to OFF. Disconnect DMM. If you **do not** have the GP-IB Option, return BIT 3 on CPU Switch 1 to OFF position and proceed to Step 11.

11. GP-IB FUNCTION (OPTIONAL)

If you have completed the Frequency and Integrator Tests, your unit is in the proper test mode. If not, verify that BIT 3 of CPU Switch 1 is **ON**. Press LOCAL switch on front panel to put unit is TEST MODE:

Display A should read 40XX

Display B should read 000000

Display C should read XXXX− −

Read all results of this test in Display A.

Address-rotate switch on rear panel to read 0−F in Display A.

XXXX0__

Addressable Address 0−F

Talk only: 2

Addressable/Talk Only − move toggle switch on and off to indicate 0 or 2 in Display A.

The address for GP-IB is held "1" at shipment and the mode is held ADDRESSABLE (0).

This concludes function tests of GP-IB.

Set Bit 3 on CPU Switch 1 to **OFF**.

12. RANGING PERFORMANCE CHECK

12.1 Automatic Range Switching (Check Voltage Range Only)

When the Vrms/Vmean ratio, expressed as a percentage exceeds approximately 110, the measured range switches automatically to the next highest range.

When the Vrms/Vmean ratio, expressed as a percentage falls below approximately 30, the measuring range switches automatically to the next lowest range.

12.2 Peak Over

Check to confirm that the voltage peak indicator lamp lights when the input voltage peak value exceeds approximately 250 % of range.

Check to confirm that the current peak indicator lamp lights when the current peak value exceeds approximately 350 % of range.

13. ANALOG OUTPUT CHECK

(1) Prepare Analog Output Connector with leads for:

V , V , V
A , A , A
W , W , W

(2) Connect AC Voltage and Current Standards according to the number of measuring elements in your unit and apply 100 V, 5 A, cosø = 1 to unit and fix ranges at 100 V, 5 A.

(3) Using DMM, verify analog outputs to be:

5 V DC ± 0.25 % (± 0.0125 V DC)

(4) This concludes test of Analog Output.

14. OPTIONAL FUNCTION CHECKS

(1) GP-IB Interface Function Check

Use a controller with GP-IB control functions to confirm that function setting and range selection by remote control can be carried out correctly for each function.

(2) Frequency Measurement

Measure the input voltage and frequency. The accuracy must be ±(0.1 % + 1 digit).

(3) Integrator Function Check

Use a standard AC voltage/current to apply 100 V AC to the voltage input terminals and 1 A AC to the current input terminals. After setting the timer to six minutes, press the "Wh" pushubutton switch, then press the integrator pushbutton switch to start integration. Confirm that the value displayed after six minutes is 10 Wh.

Integration accuracy must be ± (instrument accuracy + 0.02 % of measurement value + 1 digit)

15. VOLTAGE TESTS

(1) Range and Frequency Characteristic Tests

(a) Test set Vrms mode

Apply a standard AC voltage, at the four frequencies of 10 Hz, 60 Hz, 2 kHz and 20 kHz, as listed in the following table read the display to the voltage input terminals and on each voltage range. Input voltage and reading accuracy must be as listed in the following table.

Range		30 V	60 V	100 V	150 V	300 V	600 V
Input Voltage		30 V	60 V	100 V	150 V	300 V	600 V
Accuracy	25331□	10 Hz : ± 1 % of range 60 Hz : ± (0.1 % of rdg + 0.1 % of range) 2 kHz : ± 1 % of range 20 kHz : ± 2 % of range					
	25332□	DC : ± (0.1 % of rdg + 0.2 % of range) 10 Hz : ± 1 % of range 60 Hz : ± (0.1 % of rdg + 0.2 % of range) 2 kHz : ± 1 % of range 20 kHz : ± 2 % of range					

(b) Test set Vmean mode

Using a standard AC voltage, apply 100 V AC at four frequencies of 10 Hz, 60 Hz, 2 kHz, and 20 kHz to the voltage input terminals and read the display for each frequency. Accuracy must be as listed in the following table:

Frequency		10 Hz	60 Hz	2 kHz	20 kHz
Input Voltage		100 V fixed		Range 100 V	
Accuracy	25331□	10 Hz : ± 1 % of range 60 Hz : ± (0.1 % of rdg + 0.1 % of range) 2 kHz : ± 1 % of range 20 kHz : ± 2 % of range			
	25332□	DC : ± (0.1 % of rdg + 0.2 % of range) 10 Hz : ± 1 % of range 60 Hz : ± (0.1 % of rdg + 0.2 % of range) 2 kHz : ± 1 % of range 20 kHz : ± 2 % of range			

(2) Linearity Test

The 100 V range shall be selected, and using a standard AC voltage apply an AC voltage at 60 Hz as listed in the following table to the voltage input terminals and read the display. The test points and accuracy must be as listed in the following table:

Input Voltage		10 V	20 V	60 V	110 V
Accuracy	25331□	60 Hz : ± (0.1 % of rdg + 0.1 % of range)			
	25332□	DC : ± (0.1 % of rdg + 0.2 % of range)			

16. AC CURRENT TEST

The following tests shall be carried out for each test point in the CURRENT mode selected by the function selector switch.

(1) Range and Frequency Characteristic Tests

Using AC current standard apply an AC current at frequencies of 10 Hz, 60 Hz, 2 kHz and 20 kHz to the current input terminals and read the display on each range. The input current and accuracy for each range must be as listed in the following table:

Range		0.5 A	1 A	2 A	5 A	10 A	20 A
Input Current		0.5 A	1 A	2 A	5 A	10 A	20 A
Accuracy	25331□	10 Hz : ± 1 % of range 60 Hz : ± (0.1 % of rdg + 0.1 % of range) 2 kHz : ± 1 % of range 20 kHz : ± 2 % of range					
	25332□	DC : ± (0.1 % of indicated value + 0.2 % of range + 3 mA) 10 Hz : ± 1 % of range 60 Hz : ± (0.1 % of rdg + 0.2 % of range) 2 kHz : ± 1 % of range 20 kHz : ± 2 % of range					

(2) Linearity Test

The 1 A range shall be selected and, using AC current standard apply an AC (or DC) current at 60 Hz as listed in the following table to the current input terminals and read the display. The test points and accuracy must be as listed in the following table:

Input Current		0.1 A	0.2A	0.6 A	1 A
Accuracy	25331□	60 Hz : ± (0.1 % of rdg + 0.1 % of range)			
	25332□	DC : ± (0.1 % of rdg + 0.2 % of range + 3 mA) 60 Hz : ± (0.1 % of rdg + 0.2 % of range)			

17. POWER MEASUREMENT TESTS

The following tests shall be carried out for each point in the WATT and Σ modes.

(1) Range and Frequency Characteristic Tests

Using standard AC (or DC) power apply AC (or DC) voltage and currents at power factor 1 to the input terminals and read the displayed power.

Voltage and current range setting, input voltage and current, frequency and accuracy shall be as in the table below.

<table>
<tr><th colspan="2">Frequency, Factor</th><th>Voltage Range and Input Voltage</th><th>Current Range and Power Input Current</th></tr>
<tr><td colspan="2" rowspan="10">(D.C)
10 Hz

50/60 Hz

2 kHz

20 kHz

cosø: 1</td><td rowspan="5">100 V fixed</td><td>0.5 A</td></tr>
<tr><td>2 A</td></tr>
<tr><td>5 A</td></tr>
<tr><td>10 A</td></tr>
<tr><td>20 A</td></tr>
<tr><td>30 V</td><td rowspan="5">1 A fixed</td></tr>
<tr><td>60 V</td></tr>
<tr><td>100 V</td></tr>
<tr><td>150 V</td></tr>
<tr><td>300 V</td></tr>
<tr><td>600 V</td></tr>
<tr><td rowspan="2">Accuracy</td><td>25331□</td><td colspan="2">10 Hz : ± 1 % of range
60 Hz : ± (0.1 % of rdg + 0.1 % of range)
2 kHz : ± 1 % of range
20 kHz : ± 2 % of range</td></tr>
<tr><td>25332□</td><td colspan="2">DC : ± (0.1 % of rdg + 0.3 % of range)
10 Hz : ± 1 % of range
60 Hz : ± (0.1 % of rdg + 0.2 % of range)
2 kHz : ± 1 % of range
20 kHz : ± 2 % of range</td></tr>
</table>

(2) Linearity Test

Using AC power standard, apply the input voltages and currents listed in the following tables to each inpt terminal and read the displayed power. The current range, voltage range and accuracy must be as follows:

Item	Input Current and Voltage
Current range (1 A)	1 A fixed
Voltage range (100 V)	10 V, 20 V, 60 V, 110 V

Item	Input Voltage and Input Current
Voltage range (100 V)	100 V fixed
Current range (1 A)	0.1 A, 0.2 A, 0.6 A, 1.1 A

Power factor: 1, Frequency : 60 Hz

Accuracy	25331□	± (0.1 % of rdg + 0.1 % of range)
	25332□	± (0.1 % of rdg + 0.2 % of range)

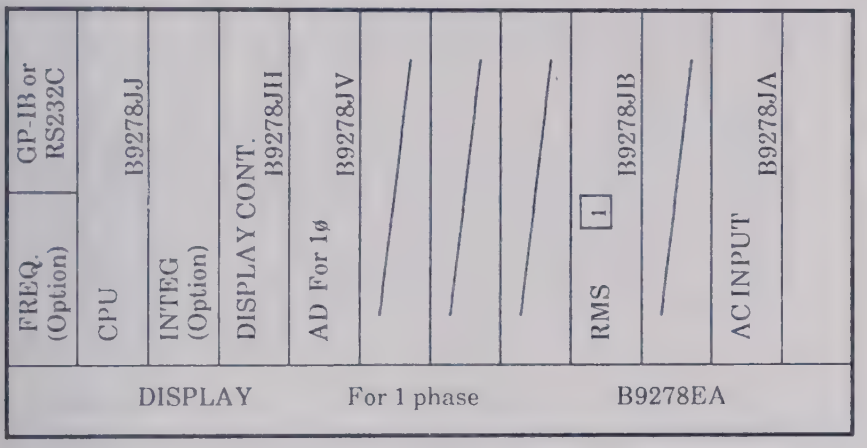
(3) Power Factor Influence Test

With each phase power and Σ power, AC voltage and current at power factor zero (for both LEAD and LAG) listed in the following table shall be applied to each input terminals and the displayed power read.

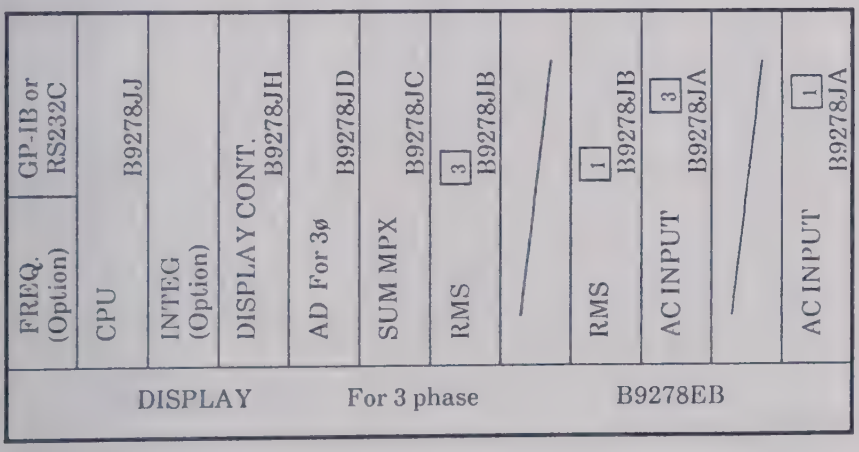
Voltage Range and Input Voltage	Current Range and Input Current	Frequency	Accuracy
30 V	1 A fixed	60 Hz	± (0.39 % of range)
60 V			
100 V			
150 V			
300 V			
600 V			

18. VARIATIONS AND KEYBOARD LOCATIONS

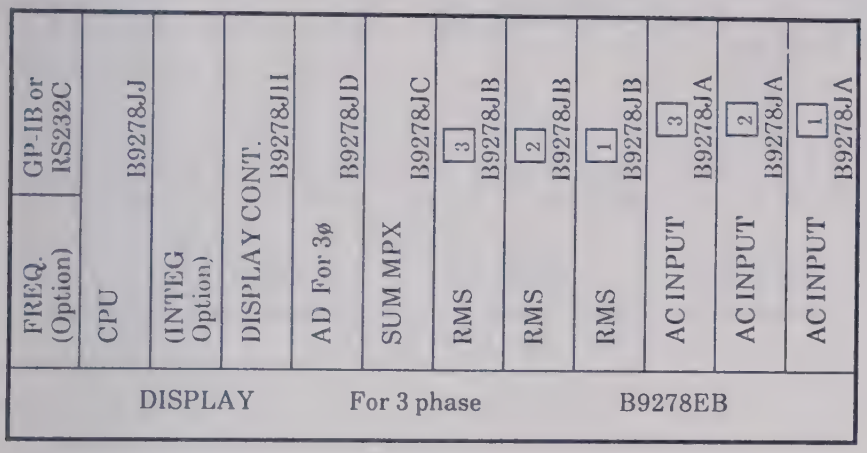
(1) 1 Phase (Model 253311)



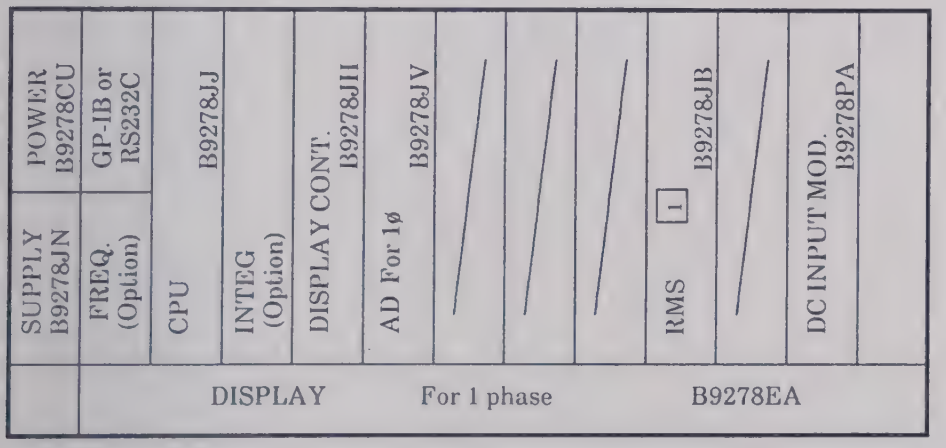
(2) 3 Phase 3 Wire (Model 253312)



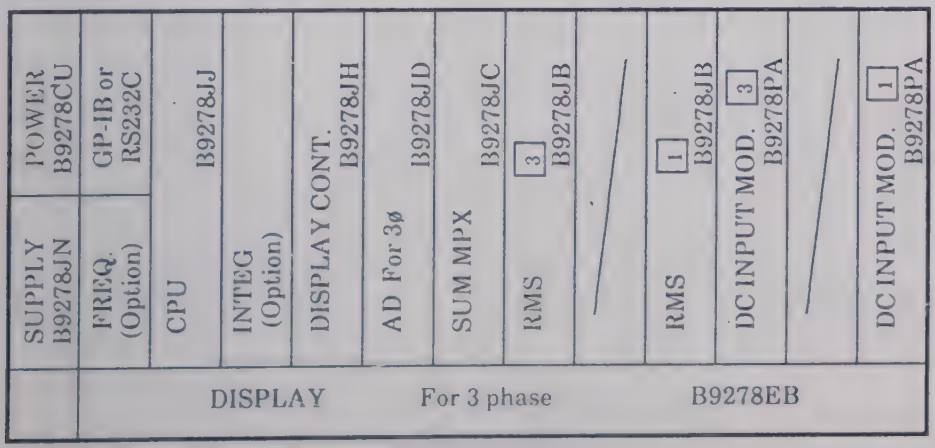
(3) 3 Phase 4 Wire (Model 253313)



(4) 1 Phase (Model 253321)



(5) 3 Phase 3 Wire (Model 253322)



(6) 3 Phase 4 Wire (Model 253323)

	SUPPLY B9278JN	POWER B9278CU	
	FREQ. (Option)	GP-IB or RS232C	
DISPLAY	CPU	B9278JJ	
	INTEG (Option)		
	DISPLAY CONT.	B9278JH	
	AD For 3ø	B9278JD	
For 3 phase	SUM MPX	B9278JC	
	RMS [3]	B9278JB	
	RMS [2]	B9278JB	
	RMS [1]	B9278JB	
B9278EB	DC INPUT MOD. [3]	B9278PA	
	DC INPUT MOD. [2]	B9278PA	
	DC INPUT MOD. [1]	B9278PA	

GE Electronic Services

YOKOGAWA 2533 DIGITAL POWER METER Data Sheet

Revision 2.00

Reference: IM 2533-03E MAR88

Included Options List

None

In Unit Under Test?

Serial Number:

GE CAP Number:

Job Number:

Tested By:

Inspected By: _____ Date: _____

SECTION 1 - VOLTAGE TESTS

Vrms Mode

Specifications:
10Hz: +- 1% of range
60Hz: +-(0.1% of rdg + 0.1% of range)
2KHz: +- 1% of range
20Khz: +- 2% of range

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
30V 10Hz	30.0V	29.70 V		FAIL	30.30 V	0.028 V	10.7 :1
60V 10Hz	60.0V	59.40 V		FAIL	60.60 V	0.046 V	13.0 :1
100V 10Hz	100.0V	99.00 V		FAIL	101.00 V	0.070 V	14.3 :1
150V 10Hz	150.0V	148.50 V		FAIL	151.50 V	0.100 V	15.0 :1
300V 10Hz	300.0 V	297.0 V		FAIL	303.0 V		#DIV/0!
600V 10Hz	600.0 V	594.0 V		FAIL	606.0 V		#DIV/0!
30V 60Hz	30.0V	29.97 V		FAIL	30.03 V	0.006 V	4.7 :1
60V 60Hz	60.0V	59.94 V		FAIL	60.06 V	0.006 V	9.4 :1
100V 60Hz	100.0V	99.90 V		FAIL	100.10 V	0.010 V	10.0 :1
150V 60Hz	150.0V	149.85 V		FAIL	150.15 V	0.015 V	10.3 :1
300V 60Hz	300.0 V	299.7 V		FAIL	300.3 V	0.031 V	9.7 :1
600V 60Hz	600.0 V	599.4 V		FAIL	600.6 V	0.058 V	10.3 :1
30V 2KHz	30.0V	29.70 V		FAIL	30.30 V	0.004 V	81.1 :1
60V 2KHz	60.0V	59.40 V		FAIL	60.60 V	0.006 V	93.7 :1
100V 2KHz	100.0V	99.00 V		FAIL	101.00 V	0.010 V	100.0 :1
150V 2KHz	150.0V	148.50 V		FAIL	151.50 V	0.015 V	103.4 :1
300V 2KHz	300.0 V	297.0 V		FAIL	303.0 V		#DIV/0!
600V 2KHz	600.0 V	594.0 V		FAIL	606.0 V		#DIV/0!

Date of Test:

Stamp:_____

Vrms Mode (Continued)

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
30V 20KHz	30.0 V	29.40 V		FAIL	30.60 V	0.004 V	162.2 :1
60V 20KHz	60.0 V	58.80 V		FAIL	61.20 V	0.006 V	187.4 :1
100V 20KHz	100.0 V	98.00 V		FAIL	102.00 V	0.010 V	200.0 :1
150V 20KHz	150.0 V	147.00 V		FAIL	153.00 V	0.015 V	206.8 :1
300V 20KHz	300.0 V	294.00 V		FAIL	306.00 V		#DIV/0!
600V 20KHz	600.0 V	588.00 V		FAIL	612.00 V		#DIV/0!

Vmean Mode

Specifications:
10Hz: +- 1% of range
60Hz: +-(0.1% of rdg + 0.1% of range)
2KHz: +- 1% of range
20Khz: +- 2% of range

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
100V 10Hz	100.0V	99.00 V		FAIL	101.00 V	0.070 V	14.3 :1
100V 60Hz	100.0V	99.90 V		FAIL	100.10 V	0.010 V	10.0 :1
100V 2KHz	100.0V	99.00 V		FAIL	101.00 V	0.010 V	100.0 :1
100V 20KHz	100.0V	98.00 V		FAIL	102.00 V	0.010 V	200.0 :1

Linearity Test

Specifications:
60Hz: +-(0.1% of rdg + 0.1% of range)

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
60Hz	10.0V	9.99 V		FAIL	10.01 V	0.001 V	10.9 :1
60Hz	20.0V	19.98 V		FAIL	20.02 V	0.002 V	11.3 :1
60Hz	60.0V	59.94 V		FAIL	60.06 V	0.006 V	9.4 :1
60Hz	110.0V	109.89 V		FAIL	110.11 V	0.011 V	10.1 :1

CTION 2 - AC CURRENT TEST

Range and Frequency Characteristic Tests

Specifications:
10Hz: +- 1% of range
60Hz: +-(0.1% of rdg + 0.1% of range)
2KHz: +- 1% of range
20Khz: +- 2% of range

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
0.5A 10Hz	0.5000A	0.4950A		FAIL	0.5050A		#DIV/0!
1A 10Hz	1.0000A	0.9900A		FAIL	1.0100A		#DIV/0!
2A 10Hz	2.0000A	1.9800A		FAIL	2.0200A		#DIV/0!
5A 10Hz	5.000A	4.950A		FAIL	5.050A		#DIV/0!
10A 10Hz	10.000A	9.900A		FAIL	10.100A		#DIV/0!
20A 10Hz	20.000A	19.800A		FAIL	20.200A		#DIV/0!

Date of Test:

Stamp:_____

Range and Frequency Characteristic Tests (Continued)

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
0.5A 60Hz	0.5000A	0.4995A		FAIL	0.5005A		#DIV/0!
1A 60Hz	1.0000A	0.9990A		FAIL	1.0010A		#DIV/0!
2A 60Hz	2.0000A	1.9980A		FAIL	2.0020A		#DIV/0!
5A 60Hz	5.000A	4.995A		FAIL	5.005A		#DIV/0!
10A 60Hz	10.000A	9.990A		FAIL	10.010A		#DIV/0!
20A 60Hz	20.000A	19.980A		FAIL	20.020A		#DIV/0!
0.5A 2KHz	0.5000A	0.4950A		FAIL	0.5050A		#DIV/0!
1A 2KHz	1.0000A	0.9900A		FAIL	1.0100A		#DIV/0!
2A 2KHz	2.0000A	1.9800A		FAIL	2.0200A		#DIV/0!
5A 2KHz	5.000A	4.950A		FAIL	5.050A		#DIV/0!
10A 2KHz	10.000A	9.900A		FAIL	10.100A		#DIV/0!
20A 2KHz	20.000A	19.800A		FAIL	20.200A		#DIV/0!
0.5A 20KHz	0.5000A	0.4900A		FAIL	0.5100A		#DIV/0!
1A 20KHz	1.0000A	0.9800A		FAIL	1.0200A		#DIV/0!
2A 20KHz	2.0000A	1.9600A		FAIL	2.0400A		#DIV/0!
5A 20KHz	5.000A	4.900A		FAIL	5.100A		#DIV/0!
10A 20KHz	10.000A	9.800A		FAIL	10.200A		#DIV/0!
20A 10KHz	20.000A	19.600A		FAIL	20.400A		#DIV/0!

Linearity Test

Specifications:
60Hz: +-(0.1% of rdg + 0.1% of range)

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
60Hz	0.1000A	0.0999A		FAIL	0.1001A		#DIV/0!
60Hz	0.2000A	0.1998A		FAIL	0.2002A		#DIV/0!
60Hz	0.6000A	0.5994A		FAIL	0.6006A		#DIV/0!
60Hz	1.0000A	0.9990A		FAIL	1.0010A		#DIV/0!

CTION 3 - POWER MEASUREMENT TESTS

Range and Frequency Characteristic Tests

Specifications:
10Hz: +- 1% of range
60Hz: +-(0.1% of rdg + 0.1% of range)
2KHz: +- 1% of range
20Khz: +- 2% of range

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
100V 0.5A 10Hz	50.00W	49.50W		FAIL	50.50W		#DIV/0!
100V 2A 10Hz	200.0A	198.0A		FAIL	202.0A		#DIV/0!
100V 5A 10Hz	500.0A	495.0A		FAIL	505.0A		#DIV/0!
100V 10A 10Hz	1000.0A	990.0A		FAIL	1010.0A		#DIV/0!
100V 20A 10Hz	2000.0A	1980.0A		FAIL	2020.0A		#DIV/0!
100V 0.5A 60Hz	50.00W	49.95W		FAIL	50.05W		#DIV/0!
100V 2A 60Hz	200.0A	199.8A		FAIL	200.2A		#DIV/0!
100V 5A 60Hz	500.0A	499.5A		FAIL	500.5A		#DIV/0!
100V 10A 60Hz	1000.0A	999.0A		FAIL	1001.0A		#DIV/0!
100V 20A 60Hz	2000.0A	1998.0A		FAIL	2002.0A		#DIV/0!
300V 1A 2KHz	300.00W	297.0W		FAIL	303.0W		#DIV/0!

Date of Test:

Stamp:_____

nge and Frequency Characteristic Tests (Continued)

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
60V 1A 2KHz	60.00W	59.40W		FAIL	60.60W		#DIV/0!
100V 1A 20KHz	100.00W	98.00W		FAIL	102.00W		#DIV/0!
150V 1A 20KHz	150.00W	147.00W		FAIL	153.00W		#DIV/0!
300V 1A cos0:1	300.00W	294.00W		FAIL	306.00W		#DIV/0!
600V 1A cos0:1	600.00W	588.00W		FAIL	612.00W		#DIV/0!

inearity Test

pcifications:
Hz: +-(0.1% of rdg + 0.1% of range)

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
10V 1A	10.00W	9.99W		FAIL	10.01W		#DIV/0!
20V 1A	20.00W	19.98W		FAIL	20.02W		#DIV/0!
60V 1A	60.00W	59.94W		FAIL	60.06W		#DIV/0!
110V 1A	110.00W	109.89W		FAIL	110.11W		#DIV/0!

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
100V 0.1A	10.00W	9.99W		FAIL	10.01W		#DIV/0!
100V 0.2A	20.00W	19.98W		FAIL	20.02W		#DIV/0!
100V 0.6A	60.00W	59.94W		FAIL	60.06W		#DIV/0!
100V 1.1A	110.00W	109.89W		FAIL	110.11W		#DIV/0!

ower Factor Influence Test

ecifications:
Hz: +-(0.39% of range)

Parameter	Nominal	Lower Limit	As Found	As Left	Upper Limit	Measurement Uncertainty	Test Accuracy Ratio
30V 1A	1.000	0.996		FAIL	1.004		#DIV/0!
60V 1A	1.000	0.996		FAIL	1.004		#DIV/0!
100V 1A	1.000	0.996		FAIL	1.004		#DIV/0!
150V 1A	1.000	0.996		FAIL	1.004		#DIV/0!
300V 1A	1.000	0.996		FAIL	1.004		#DIV/0!
600V 1A	1.000	0.996		FAIL	1.004		#DIV/0!

of Test:

Stamp:_____

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SMEAD-HASTINGS, MN
NO. 121GN